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NASA TECH BRIEF

Lewis Research Center

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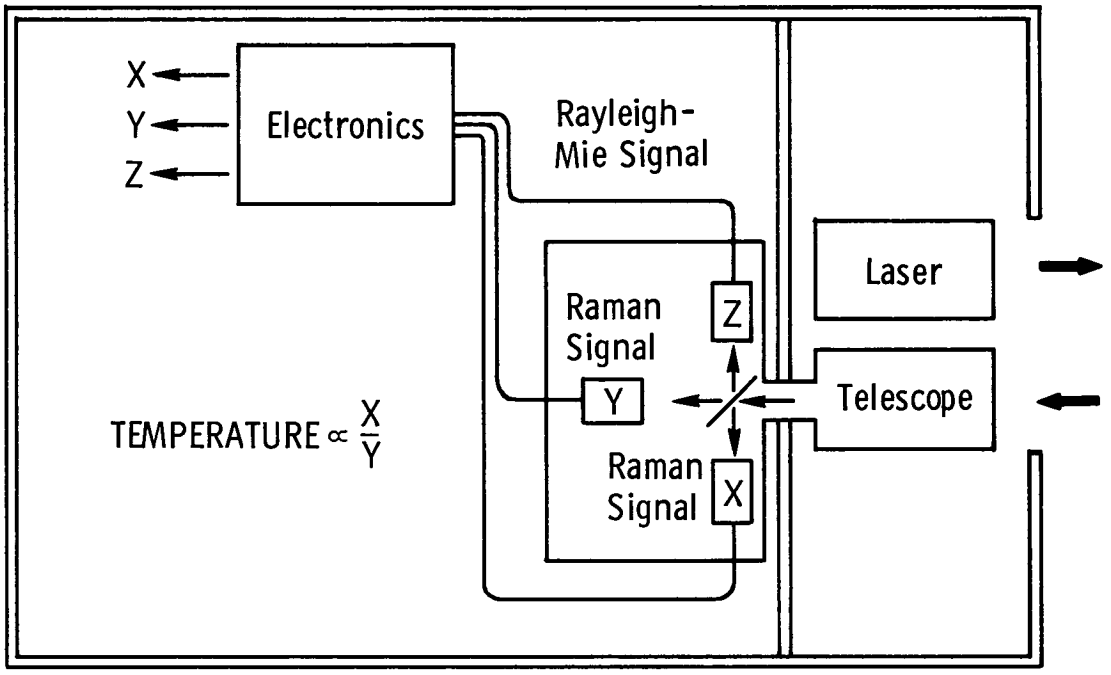
Atmospheric Temperature Measurements by Raman Laser Scattering



A system for making continuous synoptic measurements of atmospheric temperatures and temperature profiles from the ground in real time has been developed. The development is based on the principle that the intensity distribution of Raman scattered laser light is a function of temperature and it is theoretically possible to measure air temperature by analyzing its Raman spectrum. When this measurement technique is combined with the ranging capabilities of an optical radar or LIDAR (Light Detection And Ranging) system, it provides a system for remote, real-time temperature measurement. This Raman LIDAR system provides a means for more rapidly, accurately and comprehensively observing and predicting atmospheric temperature conditions and temperature-affected environmental conditions than conventional techniques such as balloon soundings.

A developmental model has been built which measures atmospheric temperatures to an accuracy of ±3 K (±5.4°F) with a temporal resolution of one minute and a spatial resolution of five meters (16.4 feet) over a range of up to 100 meters (328 feet). Useful measurements can be made well beyond this range but with less resolution. A predicted operational model will have the capability of making useful temperature measurements at ranges of one to two kilometers (0.62 to 1.24 miles).

The LIDAR unit for the developmental model consists of a 4 joule 10 ppm laser, a Schmidt-Cassegrain telescope, and a system of time-dated detection and signal processing electronics. The detection system processes three return signal wavelength intervals; two intervals along the rotational Raman scattered spectrum and one interval centered at the Rayleigh-Mie scattered wavelength. The wavelength intervals are resolved by using a pellicle beam splitter and three optical interference filters. Raman return samples are taken from one discrete range segment during each test shot and the signal intensities are displayed in digital format. The ratio of the Raman intensities yields an absolute temperature measurement.

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Notes:

1. Further information is available in the following reports:

   NASA TN-D-6879 (N72-28455), Light-Detection Electronics for a Raman Lidar

   NASA TN-D-7126 (N73-15525), Determination of the Temperature of Gas Mixtures by Using Laser Raman Scattering

   Copies may be obtained at cost from:

   Aerospace Research Applications Center
   Indiana University
   400 East Seventh Street
   Bloomington, Indiana 47401
   Telephone: 812-337-7833
   Reference: B73-10251

2. Specific technical questions may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B73-10251

Patent Status:

NASA has decided not to apply for a patent.

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